

## SPRINKLER SYSTEM RELIABILITY: PCA vs. NFPA STATISTICS

By Richard C. Schulte

In October, 2009, the Portland Cement Association (PCA) released a document titled "*Proposed Amendments to the International Building Code, 2009 edition, Relating to High Performance Building Requirements for Sustainability*". Excerpts from this document include the following:

*"Sustainability is the main difference between a high performance code and a minimum building code such as the International Building Code. Sustainability takes on many forms related to building design, construction, functionality, life cycle costs and impact to the environment. This code incorporates all of these features and combines them into a comprehensive high performance sustainable building code."*  
(Section C101.3, page 1)

**"HIGH PERFORMANCE FIRE SAFETY.** Throughout the International Building Code (as well as other building codes), fire resistance ratings, egress widths, travel distance and many other safety features are relaxed or completely eliminated due to the presence of an automatic sprinkler system, while the building height is allowed to be increased by 1 story and areas increased by 200 to 300 percent. While these systems have a good record in controlling fire and allowing escape, they are still vulnerable to human factors. National Fire Protection Association (NFPA) states that sprinkler failure rates, called accidental fire events, are at best currently over 10 percent. These statistics do not include instances when the system was shut off either intentionally or by accident. Permitting sprinkler trade-offs for fire safety, structural integrity and egress, raises the potential for death, injury, facility shutdown, repair construction, worker displacement and other hindrances to efficient facility operations. If a sprinkler malfunction or failure occurs, building elements that have been allowed a reduction in hourly ratings are the only immediate defense remaining to contain or stop the spread of fire. The resiliency of high performance buildings depends on both active suppression and passive compartmentation without allowable hourly reductions, to reasonably guarantee that fire does not spread past the area or room of origin."

Since the reliability of sprinkler systems has been the subject of much debate over the last ten years or so, the National Fire Protection Association (NFPA) has addressed this issue several times in the last few years. As of this writing, the latest report on the reliability of sprinkler systems issued by NFPA is titled "*U.S. Experience with Sprinklers and Other Automatic Fire Extinguishing Equipment*" dated January 2009. The author of this report is Dr. John R. Hall, Jr. of the Fire Analysis and Research Division of the NFPA. The following are excerpts from this report:

"Sustainability takes on many forms related to building design, construction, functionality, life cycle costs and impact to the environment."

"When sprinklers cover the area of fire origin, they operate in 95% of all reported structure fires large enough to activate sprinklers. When they operate, they are effective 96% of the time, resulting in a combined performance of operating effectively in 91% of reported fires where sprinklers were present in the fire area and fire was large enough to activate sprinklers." (Abstract)

"National Fire Protection Association (NFPA) states that sprinkler failure rates, called accidental fire events, are at best currently over 10 percent. These statistics do not include instances when the system was shut off either intentionally or by accident." PCA

"Also, when sprinklers are present in structures that are not under construction and excluding cases of failure or ineffectiveness because of a lack of sprinklers in the fire area [i.e. partial protection], 94% of reported structure fires have flame damage confined to the room of origin compared to 74% when no automatic extinguishing equipment is present." (Abstract)

". . . .resulting in a combined performance of operating effectively in 91% of reported fires . . ." NFPA

"The combined performance for the more widely used wet pipe sprinklers is 92%, while for dry pipe sprinklers, the combined performance is only 77%." (Page I)

*“Sprinklers apparently are still rare in many of the places where people are most exposed to fire, including educational properties, offices, most stores, and especially homes, where most fire deaths occur.” (Page 1)*

*“When sprinklers fail to operate, the reason most often given (63% of failures) was shutoff of the system before fire began . . .” (Page 1)*

*“Wet pipe sprinklers operated and were effective in 92% of fires vs. 77% for dry pipe sprinklers.” (Page vii)*

*“When wet pipe sprinklers operated, 88% of reported fires involved only 1 or 2 sprinklers.” (Page viii)*

*“For dry pipe sprinklers, 73% involved only 1 or 2 sprinklers.” (Page viii)*

*“In 2006, automatic extinguishing equipment was reported in only 1% of fires in one- or two-family dwellings and only 16% of fires in apartments.” (Page 3)*

*“Sprinkler usage is higher in the West region than in other regions and lower in rural areas than in non-rural areas.” (Page 4)*

*“Because sprinkler systems are so demonstrably effective, they can make a major contribution to fire protection in any property.” (Page 4)*

*“The major property class with the largest share for dry pipe sprinklers was storage, where dry pipe sprinklers accounted for 21% of the systems cited.” (Page 5)*

*“Sprinklers in the area of fire failed to operate in only 5% of reported structure fires large enough to activate sprinklers.” (Page 13)*

*“The other estimated failure rates corresponding to percentage operating rates shown in Table 3 a*

- 4% for wet pipe sprinklers,
- 16% for dry pipe sprinklers, . . . .” (Page 13)

**“The combined performance for the more widely used wet pipe sprinklers is 92%, while for dry pipe sprinklers, the combined performance is only 77%.” NFPA**

**“When wet pipe sprinklers operated, 88% of reported fires involved only 1 or 2 sprinklers.” NFPA**

*“For major property classes and sprinklers, the estimated failure rates range from a low of 2% for residential properties to a high of 21% for storage properties. For storage properties, the estimated failure rates are 15% for wet pipe sprinklers and 49% for dry pipe sprinklers.” (Page 13)*

*“For sprinklers that operated, effectiveness was uniformly high in all property classes. Effectiveness was higher for wet pipe sprinklers (97% for all structures) than for dry pipe sprinklers (91%).” (Page 27)*

*“Combined performance was 91% for all sprinklers, 92% for wet pipe sprinklers, and 77% for dry pipe sprinklers, all measured for all property types combined.” (Page 28)*

*“For all structures combined, 74% have flame damage confined to room of origin when there is no automatic extinguishing equipment present. This rises to 94% of fires with flame damage confined to room of origin when any type of sprinkler is present.” (Page 29)*

*“Five or fewer heads [sprinklers] operated in 97% of the wet pipe system activations and 87% of the dry pipe system activations.” (Page 30)*

*“Dry-pipe systems are much more likely to open more than one sprinkler than wet pipe systems (43% vs. 24% of fires).” (Page 30)*

*“When more than 1-2 sprinklers have to operate, this is often taken as an indication of less than ideal performance.” (Page 31)*

*“For 2003-2006 home fires, the death rate per 100 fires was 80% lower with wet pipe sprinklers than with no automatic extinguishing equipment.” (Page 32)*

*“The estimated reduction was 87% for one- or two-family dwellings and 65% for apartments.” (Page 32)*

*“Most property groups average too few deaths per year in sprinklered properties to produce stable statistical comparisons. Only apartments and property use groups that include apartments – such as homes and all residential properties – averaged at least 5 projected deaths per year in sprinklered properties.” (Page 33)*

**“For major property classes and sprinklers, the estimated failure rates range from a low of 2% for residential properties to a high of 21% for storage properties. For storage properties, the estimated failure rates are 15% for wet pipe sprinklers and 49% for dry pipe sprinklers.” NFPA**

*“A zero death rate for sprinklered properties was estimated for public assembly properties, eating or drinking establishment, educational properties, stores and offices, and office properties. Health care properties and hotels and motels both have a high percentage of fires in sprinklered properties, but not so high that the death rate estimates for non-sprinklered properties become statistically unstable. They show 80% and 74% reductions, respectively, with wet pipe sprinklers.” (Page 33)*

*“Manufacturing facilities show a small reduction in an already low death rate, while warehouses show no reduction.” (Page 33)*

**“A zero death rate for sprinklered properties was estimated for public assembly properties, eating or drinking establishment, educational properties, stores and offices, and office properties. Health care properties and hotels and motels both have a high percentage of fires in sprinklered properties, but not so high that the death rate estimates for non-sprinklered properties become statistically unstable. They show 80% and 74% reductions, respectively, with wet pipe sprinklers.” NFPA**

## Discussion

While the Portland Cement Association indicates that the failure rate of sprinkler systems reported by the National Fire Protection Association exceeds 10 percent, even when sprinkler system

failures caused by closed water supply valves are excluded, the NFPA report on sprinkler system reliability dated January 2009 indicates that sprinkler systems perform effectively (successfully) in 91 percent of the fires large enough to activate sprinklers and that this statistic includes failures caused by closed water supply valves. Obviously, either the sprinkler system failure rate cited by the Portland Cement Association in its “sustainable buildings code” proposal, or the National Fire Protection Association’s statistic on sprinkler system reliability is incorrect.

**Who’s correct, the PCA or the NFPA?**

**Who’s correct, the PCA or the NFPA?** Based upon the excerpts from Dr. John Hall’s report on the reliability of sprinkler systems above, it’s apparent that the Portland Cement Association has gotten its facts wrong about the reliability of sprinkler systems.

As previously indicated, the debate over the reliability of sprinkler systems has continued for close 10 years now with various passive fire protection product manufacturers taking turns telling us that the sprinkler system failure rate exceeds 10 percent. PCA is just the latest trade association trying to “peddle” erroneous statistics on the reliability of sprinkler systems.

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Given that the NFPA report on the reliability of sprinkler systems was published in January 2009 and that the PCA’s statement that the failure rate of sprinkler systems exceeds 10 percent, even when failures due to closed valves are excluded, is dated October 2009, it is not unreasonable to conclude that the error was intentional. In fact, it is not unreasonable to conclude that the passive fire protection products manufacturers have been intentionally citing erroneous statistics on sprinkler system reliability for the last 10 years.

Why would the passive fire protection manufacturing interests cite erroneous statistics about the reliability of sprinkler systems? The answer to that question seems pretty obvious. Since the development and publication of the first edition of the International Building Code (IBC), the 2000 edition, the passive fire protection interests have been losing market share due to the sprinkler “trade-off” provisions included in the IBC.

It also seems obvious that PCA’s “high performance” buildings proposal is all about market share for manufacturers and installers of passive fire protection products.

It also seems obvious that PCA’s “high performance” buildings proposal is all about market share for manufacturers and installers of passive fire protection products. The statistics on sprinkler system reliability included in NFPA’s January 2009 report speak for themselves.

## Conclusion

Are the reductions in passive fire protection permitted by the IBC and the codes published by the National Fire Protection Association when sprinkler protection is provided justified? Based upon the reduction in fire fatality statistics when sprinkler protection is provided, there is little doubt that the sprinkler “trade-offs” are justified. The reductions in passive fire protection help offset the installation and maintenance costs of sprinkler systems and encourage building owners to install sprinkler protection.

There is no more effective form of fire protection for both building occupants and the building than sprinkler protection. Given this, building owners should be encouraged to install sprinkler protection and sprinkler “trade-offs” do just that.

While the sprinkler reliability statistics indicated above are very good, there is still room for improvement in these statistics. Simply by enforcing the fire prevention code provisions which mandate that sprinkler protection be maintained, the sprinkler reliability statistics can be significantly improved. Whether or not fire departments will begin to actually enforce the sprinkler system maintenance provisions contained in fire prevention codes is another matter. I guess it depends upon the fire service’s commitment to providing fire protection for building occupants and also for fire fighters.

The fire service’s commitment to fire protection can be judged on their efforts to make sure that the fire prevention code is enforced. At this point in time, there is still plenty of room for improvement with respect to the enforcement of the code provisions which mandate the maintenance of sprinkler systems.

Although the Sofa Superstore in Charleston, South Carolina was not protected by a sprinkler system, it can be said that the Charleston Fire Department found out the hard way why fire code enforcement is so critical to safety on the fire ground. In the fire at the Sofa Superstore, the fire spread through openings in two separate fire walls due to the failure of the fire doors protecting openings in the walls to close automatically. (A passive fire protection system failure.) If the building had been protected by a sprinkler system (provided due to incentives to install sprinkler protection (i.e., sprinkler “trade-offs”),) there is a very high probability that the nine fire fighters who died in this fire would still be alive today.

Sprinkler protection not only reduces civilian fire fatalities, but also reduces fire fighter fatalities. Whether you’re concerned about preventing civilian fire fatalities or fire fighter fatalities, or both, making sure that sprinkler protection is properly maintained should be important to you.

The fire service should remember that the life you save by enforcing the sprinkler system maintenance provisions contained in the fire code may be your own.

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